Space Weather Technical Forecast

Issued on Monday, 01 April 2024 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Activity declining, with a decreasing chance of M-flares. Active to G1 Minor Storm intervals expected Day 3 (03 Apr) due to arrival of CH16/CH17 fast wind.

Analysis of Space Weather Activity over past 24 hour

Solar Activity: Activity has been Moderate with a double peaked M3.9 at 01/0132 UTC (and M3.3 at 01/0142). This appeared to be a dual flare, comprising components from AR3625 in the northwest and AR3615 from over the southwest limb. AR3615 has visible looping still just about evident on SDO imagery, as such any large flares from this region may still be observable. The only notable recent sunspot development on the Earth-side was the emergence of a small region, AR3625, near the northwest limb. This region was implicated in the double peak flare earlier, but this may have been sympathetic flaring with AR3615. Overall, it looks a fairly straightforward region, although its proximity to the limb means we are unable to see the finer detail in its magnetic structure.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Fast wind conditions were observed, likely from a combination of CH15/+ and CH13/+. Solar wind speeds measured by DSCOVR at L1 were slightly elevated to elevated, mostly varying between 420-520 km/s. Density of the wind remained around average. Total Interplanetary Magnetic Field (IMF), Bt, was weak to moderate, peaking near 10nT between 31/2000-2400 UTC. The north-south component, Bz, varied mostly weakly between +8/-6nT. Phi angle remained mostly positive (away from the Sun), with some recent negative variations. Geomagnetic activity was Quiet to Unsettled (Kp1-3) but with one Active (Kp4) interval 01/0600-0900 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES-18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The associated 24-hour fluence remained below Active on a declining trend, with a value of 1.93e6 integrated pfu at 01/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is expected to decline as AR3615 rotates well onto the far-side with only smaller sunspot regions currently on the disc. There is a chance that any significant flares could still be observed from the Earth-side on Day 1 (01 Apr), but otherwise Low activity is most likely.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, although this is only moderate confidence with a small chance of a glancing arrival on Day 2 (02 April) from a weak CME that left the Sun on 29 Mar. Otherwise current elevated wind speeds, due to the fast wind from CH15/+ or CH13/+, are expected to gradually ease Days 1-2 (01-02 Apr). The next enhancement, from the combined influence of CH16/- and CH17/- is then expected Day 3 (03 Apr) with any enhancement gradually easing from Day 4 (04 Apr).

Geomagnetic activity is forecast to be mainly Quiet on Days 1-2 with a slight chance of Unsettled to Active intervals from current fast wind or possible CME influence. Activity then increasing to be Active with G1 Minor Storm intervals due to the fast wind onset Day 3 and perhaps early Day 4, before easing to Quiet to Unsettled with a chance of Active intervals.

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES18, is

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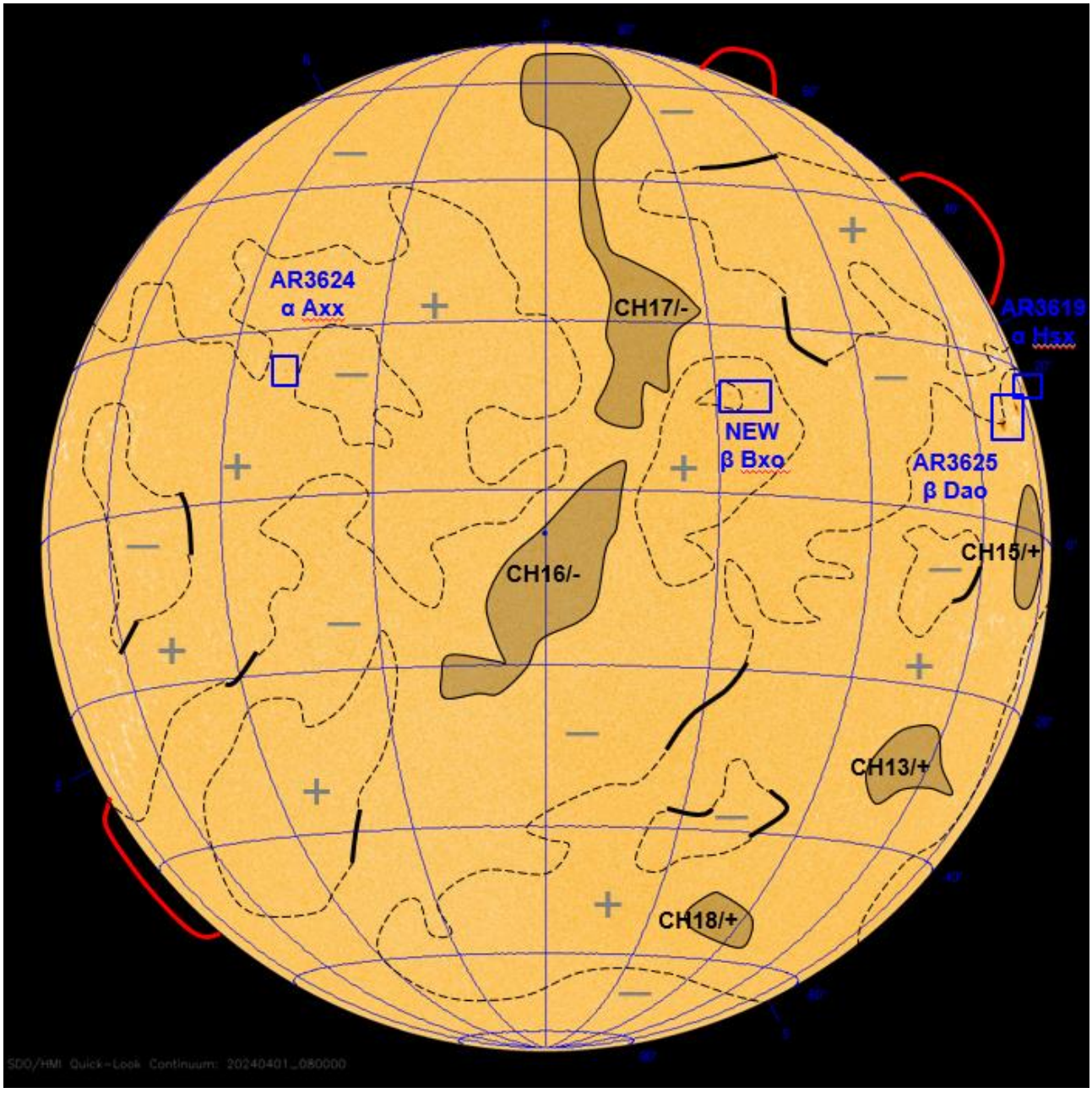
expected to be near background levels, but with a slight chance of enhancement given any strong flares from AR3615 just over the southwest limb. High energy electron flux is expected to persist at background levels until the next fast wind enhancement on Days 3-4 (03-04 Apr). The associated fluence will persist below the Active threshold, but with a slight chance of rising above by the end of Day 4.

Figure 1. Solar Analysis Valid 01/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs, however this is only moderate confidence. This is due to the potential for a very slight glancing interaction from a CME which left the southwest disc on 29 Mar, with a weak enhancement possible on Day 2 (02 Apr).

Earth is currently seeing fast wind influence from positive polarity CH15/+ and/or CH13/+. These winds are expected to erratically ease through Days 1 and 2 (01-02 Apr) before the onset of a further coronal hole fast wind from negative polarity CH16/- and CH17/-. These are recurrent features, but much more prominent on this rotation. They are also more likely to give a geomagnetic response at this time of year than the current (positive) fast wind due to their negative polarity. An earlier arrival is expected compared to that indicated in either Enlil or 27-day persistence, more likely early on Day 3 (03 Apr). Ongoing fast wind effects are then expected into Day 4 (04 Apr), before easing later in the day.

Geomagnetic activity is forecast to be mainly Quiet on Days 1-2 with a slight chance of Unsettled to Active intervals from current fast wind or possible CME influence. Activity then increasing to be Active with G1 Minor Storm intervals due to the fast wind onset Day 3 and perhaps early Day 4, before easing to Quiet to Unsettled with a chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	50	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Very low risk of some Earth directed influence on 02 April.

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Figure 2: Comparison of AIA-211 imagery between last rotation (left) and this rotation (right), showing much stronger CH16 and CH17 than last time around.

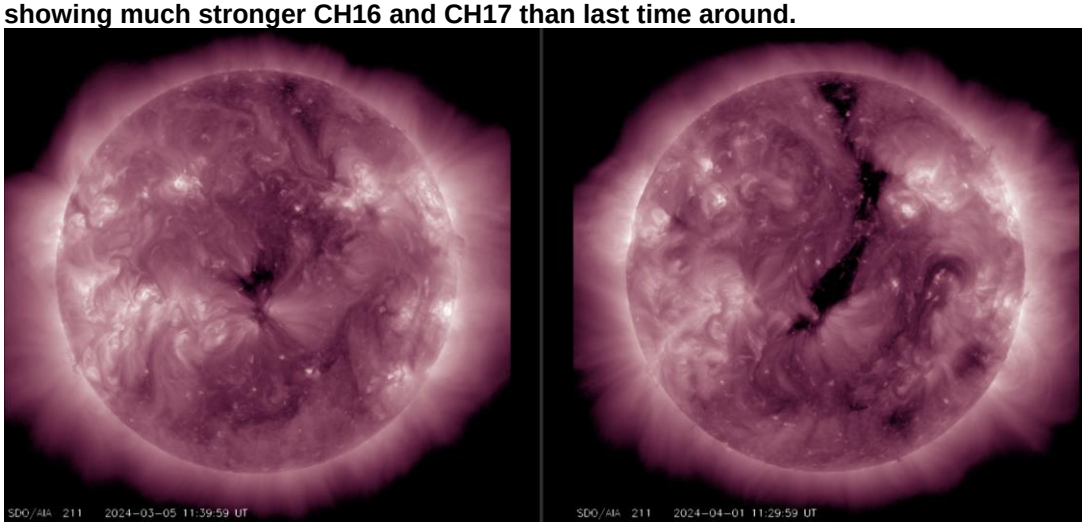
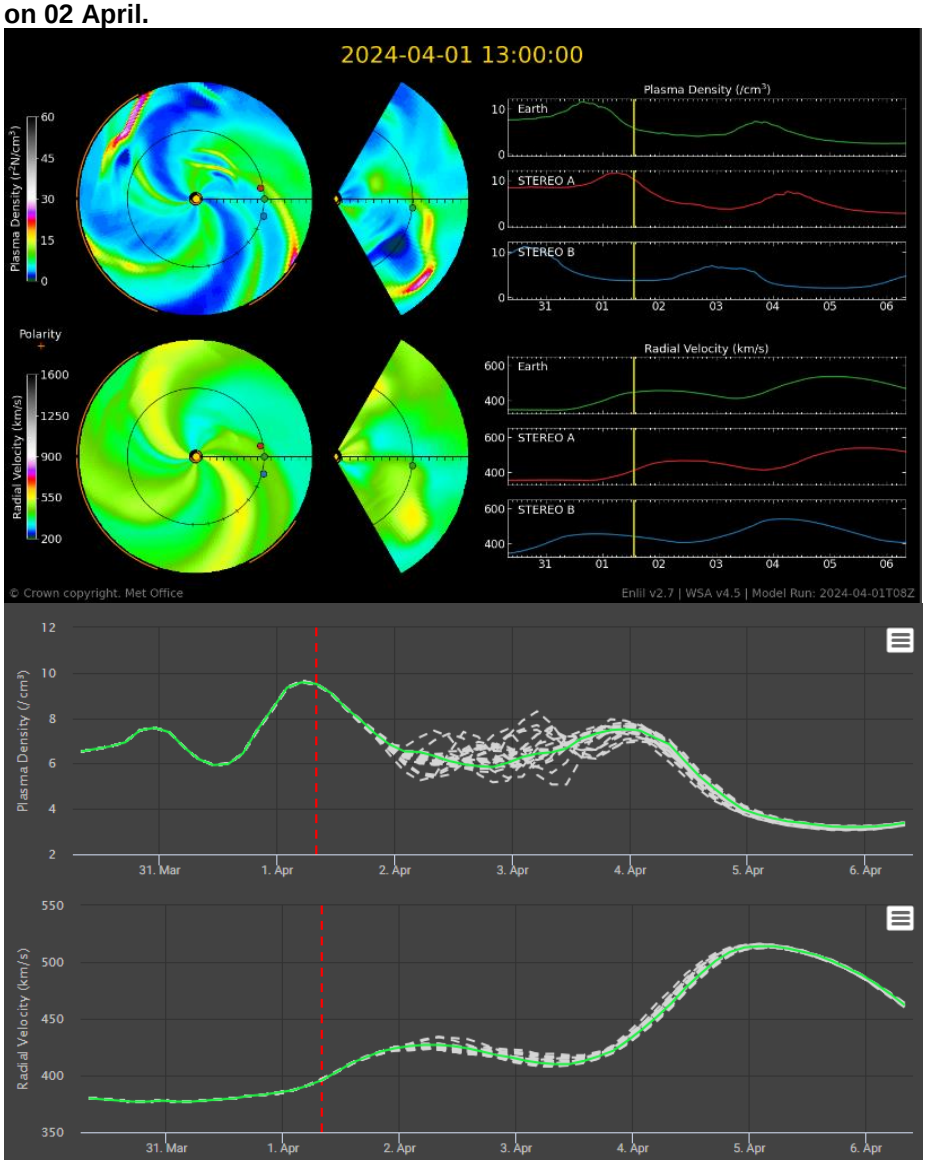


Figure 3: MOSWOC Enlil showing a HSS onset 03-04 April, however this is likely to be a little earlier than forecast by Enlil. Also Enlil ensemble showing a very slight possibility of a glancing CME blow on 02 April.



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Radio Blackouts - X-Ray Flares:

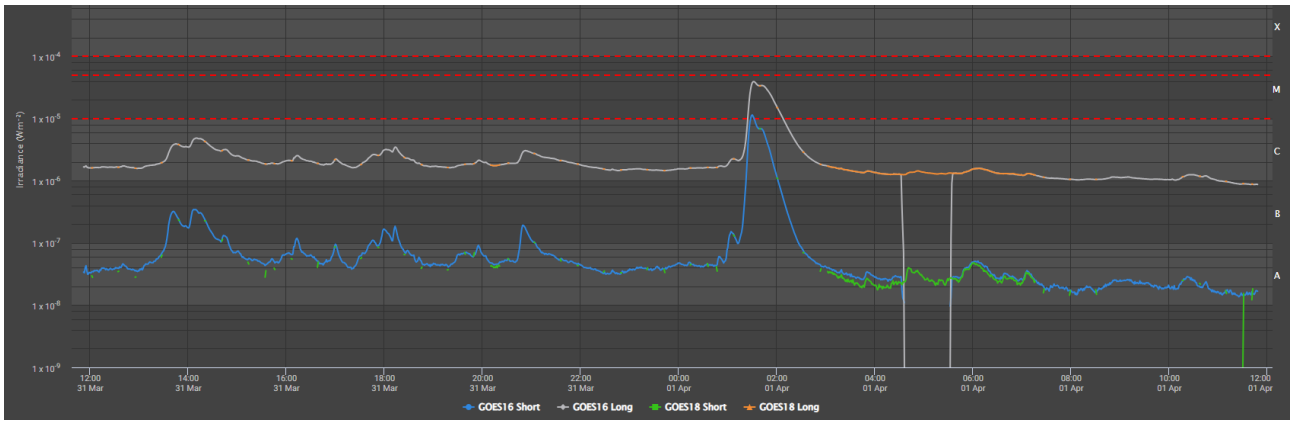
Activity has been Moderate with a double peaked M3.9 flare at 01/0132 UTC (and M3.3 at 01/0142). This appeared to be a dual flare, comprising components from AR3625 in the northwest and AR3615 from over the southwest limb. AR3615 has a declining risk of further flares, with the magnetic looping of the spot still just about visible over the southwest limb, however this risk is will soon disappear as it moves further away from the limb. Overall, a trend to mainly Low activity is expected, but still a chance of M-flares at first.

The only notable recent sunspot development on the Earth-side was the emergence of a small region, AR3625, near the northwest limb. This region was implicated in the double peak flare earlier, but this may have been sympathetic flaring with AR3615. Overall, it looks a fairly straightforward region, although its proximity to the limb means we are unable to see the finer detail in its magnetic structure.

Ex-AR3612, which developed near the northwest limb around 14 days ago, and produced an M-flare as it rotated off, has the potential to return onto the northeastern limb by Day 3 (03 Apr). There are some indications of magnetic strength in a similar location on far-side helioseismic imagery, however this is low confidence.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	10	20	20
Very Active	R3 to R5 X Class	No	5	1	1	1

Figure 4: X-ray flux at GOES16 and 18, showing the dual peak M-flare from AR3615 and AR3625.



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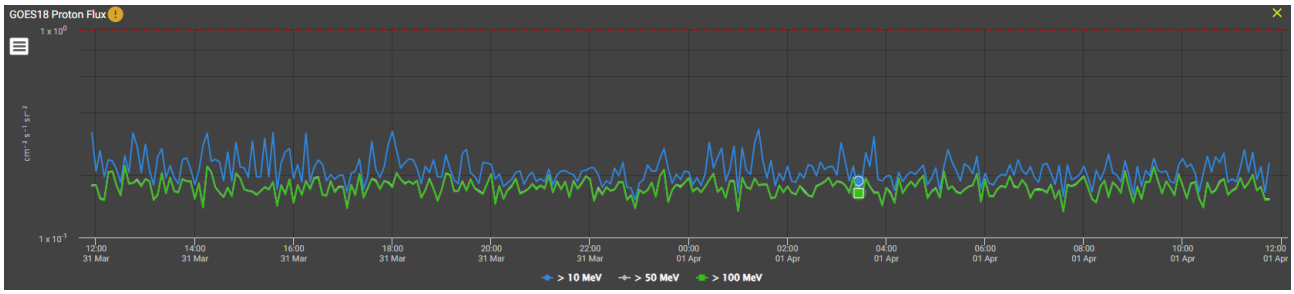
Solar Radiation Storms - (High Energy Protons):
High energy proton flux observed by GOES-18 is now at background levels, and none of the visible spots are currently expected to produce proton rich flares.
The main risk of any enhancement to the proton flux is from AR3615, which is now over the southwest limb and moving further onto the far-side. Significant flares from this region are still possible, and could still result in protons redirected towards Earth along the Parker Spiral. If such an enhancement was to occur on Day 1 or perhaps early Day 2 (01-02 Apr), any increase to proton counts could persist for a few days. The likelihood for onset of such an event is expected to decline Day 2 onward.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	10	5	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: Proton flux at GOES18, currently at background levels.



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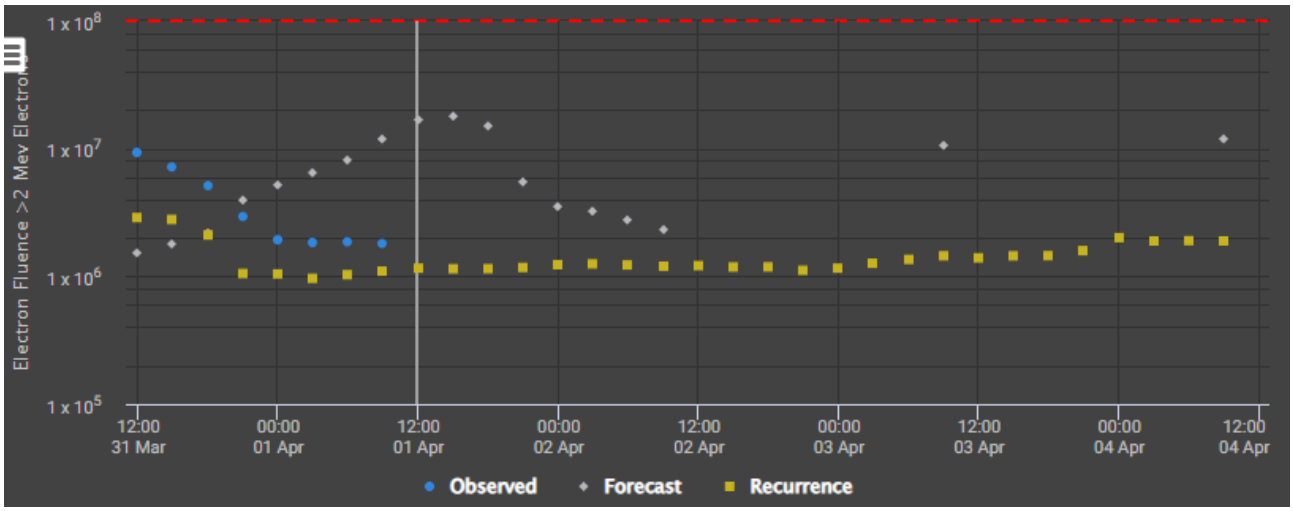
High Energy Electrons Event (≥ 2MeV):
GOES-16 high energy electron flux at GEO has persisted at background levels, with no significant enhancements expected until the onset of any fast wind from CH16/17. This is currently forecast to occur on Day 3 (03 Apr), with electron count rates likely climbing as a response on Day 4 (04 Apr), potentially reaching High by the end of the day.

The associated 24 hour fluence is expected to remain steady, well below the Active (1e8 integrated pfu) level, on Days 1-3, before rising gradually through Day 4. This will bring a slight chance of reaching the Active threshold by the end of the period, but most likely to occur beyond this period. REFM is providing a good guide to current conditions, however it is unlikely to forecast any increase in fluence until after the fast wind arrives at Earth.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 6: MOSWOC REFM showing a below Active trend, which is good in the short term but may be an underestimate by Day 4 (04 April).



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